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MILITARY GEOLOGY

Chapter 2. MISTORY OF THE DEVELOPMENT OF MILITARY GROLOGY

Geology in Military Science up to World War I

As early as 1868, the British Maj-Gen John Fortheck, who was at the came time a general and a geologist, said in his article, "A Rudimentary Transline on Geology":

"At the present time geology is a genuine actione, based or facts out erect laws, according to which it constitutes a true guide for prestical action. The military man thus finds in geology valuable instruction in planning ofther offensive or defensive operations."

The application of geology to military problems was given the most consideration by French geographers, nince Franco led the other countries at that time in military topographical research. In France, especially in the northern and castern parts, the relationship of the river systems and the various relief features to the geological structure of the locality and its bistory is so plearly expressed that it is not actomishing that the France, perceiving this relationship, were the first to recognize the utility of geology for military topography.

In the interests of their country's defense, French commanders had for a long time been obliged to make a systematic and datailed study of the natural conditions of their country, which has been the battlefield of many European wars.

Geology was studied from the military point of view for the first time and most thoroughly by Parendiere in his work which appeared in Paris in 1882 under the title of Topographic strategique et prodrome de geologie militaire (Strategical Topography and Introduction to Military Geology).

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Later, in the 1890's, a course of lectures was offered on this subject by Captain Vallet at the La Fere infantry school. The question of the influence of physicogeographical conditions upon the conduct of military operations was clearly presented in the work of A. Marga, which emphasized the influence of soil and geological conditions upon the solution of problems concerning the swift transfer of troops, the location of lines of defence, etc.

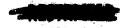
The most consistently maintained physicogeographical trank is found in Barre's published lectures at the artillery and engineering school at Fontaine-bleau. Barre was both a good engineer and a prominent geologist. In his works, he illustrates with numerous examples the great importance of tectonics and geology to military operations. As Brooks points out, Barre foresaw, with astenishing accuracy two decades beforehand, the influence which afterwards was to be made manifest by the physicogeographical conditions of the Western European theater in the course of operations from 1914 - 1918.

In other countries, military geology was not studied systematically before World War I. It may be noted, however, that in the 1880's and 1890's of
the last century, British officers who received instruction in Camberley War
College had a rather good preparation in geology. The course of lectures on
military geology at that school was given by the widely-informed and prominent
geologist, Lt Col Ch. Cooper-King, RA. King was evidently the first British
professional military man who recognized the necessity of wide application of
geology in military science. His lectures analyzed in sufficient detail and
with illustrative examples the influence of geology and its significance in
military operations.

The conception of military geology evidenced during World War I was unknown until then. The first military-geological program was formulated in 1913 by the Germen geologist, Krenz, who, beginning in 1908, participated in the construction of a number of fortresses as an officer of the engineers. In his study, "Military Geology" published in the magazine, Krisgotechnische Zeitschrift, (Military Technical Magazine), he sets forth the results of his geological observations during the building of the fortresses. He enalyzed in detail the role of subsoil waters in the water supply of military objectives and also the importance of mineral construction materials in military engineering work.

Military Geology in World War I

In World War I the application of geology and the use of military and civilian geologist in immediate connection with the armies of the belligerent powers was found to be in direct relation to the nature of the organization of military-geological services. Since each country's militariets undergrood the geologist's war role differently, the use of geology as an auxiliary military implement and the organization of military-geological services in the various armies differed. In cortain samies a special, military-geological service was organized; in others there was mone, and in working out militarygeological objectives, geological institutes, and individual civilian geologists were called upon. That was the case in the Russian and French Armies. In the British, American, German and Austrian Armies a special militarygeological service was organized. The basic objectives which then confronted the various peologists derived from the predominantly positional character of the past war and consisted mainly in finding a basis for two troops' wateramply, in fortification works, particularly in underground mine work, in the search for construction materials, and in various types of specialized geologi-Gal works.



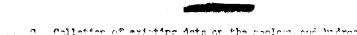
The Fundian Army was already resorting to the sid of geologists in the Russian-Japanese War, 1904-1905. The geologists, called into the army without having specialized preparation for the work, could not render effective service, in spite of the fact that such service was badly needed in the construction of fortresses. Such unsuccessful experience, however, did not draw the attention of the high command of the Tsarist army to any great degree. Consequently, the Russian Army began World War I as unprepared in military-geology as the armise of the other countries.

There was no specialized military-geological service, but the need for goological sid became apparent from the very beginning of hostilities in contern Prusein and Gelicia. In view of this, several civilian organizations can to the sid of the front, particularly the Department of Lend Improvement of the Ministry of Agriculture, which had already drawn up in 1914 a special hydrotechnical organization for the needs of the active erry. That organization stayed deep in the rear, and its work was limited to technical consultations and insignificant measures for the improvement of water-supply and contery-technical examplements for hospitals, staging exces, etc.

Not until it was transferred to Warsew did the nature of this organization's activity change comewhat, although its main role consisted, as before, of works connected with the improvement of water-supply and conitary-technical measures. In addition, works of a different nature began to be realized: draining of transhes and land, improvement of roads in swamps, flooding and making awamps of certain areas and many other types of work on the Novegoorgiev and Ivangored fortreeses. At that time, geologists were drawing conclusions only on the besis of existing literature and archival data without any hydrogeological field explorations whetecever, for there was no time for them under conditions of verfere of mensurer. Later, four administrations of military-geological works were formed to serve the northwestern, western, southwestern, and Caucasian frante. The administrations were subordinate to the officers in charge of front-line engineering services.

among the tasks of the hydrogeological section of such administration wars included the following:

- 1. Distribution, to engineer-hydrotochnicisms, of information concerning the geological structure of the section within whose limits the administration's works were carried on.
- 2. Formulation of conclusions on hydrogeological conditions of flooding, swemping, and drainage works, by region.
- Execution of field hydrogeological investigations in the various sections.
- 4. Formulation of conclusions on the accuracy of projects from the hydrogeological etc. moint and cetimated on the construction of tubular wells.
 - 5. Hydrogeological observation during the process of drilling.
- 6. Formulation of conclusions, in case of difficulties arising during the drilling process, caused by the peculiarities of the hydrological conditions of the locality.
 - 7. Formulation of colleted tables for each shaft drilled.
- 8. Scientific laboratory processing of drilling data, drilling notes, daily records, pross sections.



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Bite of operations.

10. Registration of all previously drilled and equipped shafts in the region of the hydrogeological administration's works.

The geologists were obliged to devote a great deal of attention to the accorbly and systematization of material on previously drilled shafts, since evailable data was limited and there was not sufficient time to solve a great many practical problems.

Towards the and of the ver, a technical department, attached to the construction-recipiool unit of the vestern front (Russia's vestern front), was arrestated. The department conculted with the geologists, A. S. Sargeyev and G. A. Thereburhitov. On the initiative of f. I. Valichko, Chief Regimen of the Southwestern Front, geologists were sestined to search for experiention untertials (especially non-materials for the preparation of cement) and norseabled upon for consultations on bleeting works and for the search for fuel, of which there was a shortage.

On the initiative of the Chief Engineer of the Highth Army (in Bekevine), consultant geologists were called upon for road work and for prospecting for various field winerale (for exemple, selt, dyestuff) and for consultations on notice for patablishing positions, rise galleries, atc.

Another organization which left more or less noticeable braces of the activity in the field of geological service to the Russian Army was the Raw Moterials Commission attached to the chemical department of the Hilliams-technical Service of the combined scientific and technical organizations. The Few Reterials Commission was organized at the end of 1915 at the instinction of V. I. Vernedsty and A. E. Fersman.

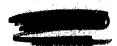
Among the duties of the consistence were the rollowing: (1) systematic accounting of stores of mineral reventerials and their consumption by the terious organizations; (2) consultations upon the exploitation and use of mineral raw materials for defense needs; (3) issuing of reference maps of construction materials and field minerals in the front-line cross.

Many works connected with the geological servicing of the front during World War I were likewise carried on by the former Geological Commission of the Department of Mines. Under the guldence of the geologists, M. M. Prigorovskiy and N. F. Pogrebov, the commission organized the distribution of necessary and urgent information in snewer to the inquiries of the various organizations serving the current needs of the active army and the economy of the country.

The Geological Commission rendered technical sid to the surveying party of the Military-Industrial Committee in its search for beds of minorel fuel on the Caucasian Front (D. V. Nalivkin, A. A. Stoyanov, B. F. Maffert, et al.).

Similarly, no military-geological cervice was organized in the French Army, and all its needs were served by civilian organizations. Only towards the end of the war did officers of the engineers of the French Army begin to function in their capacity as geologists. (They were attached to the commanding staff, to the armies, and to the water-supply service.)

As the war on the Western Front was vaged mainly on French territory, the majority of officers of the French Army, having a fairly sound preparation in geology, knew very sell that the geological service was less important for them than for the expeditionary forces of her allies and for Germany. The Germans showed how dearly they paid for their lack of knowledge of the geological literature of the neighboring countries, particularly France and Belgium,



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on whose territory they were obliged to wage war. Many French engineers, who worked on the water-curply acrvices in the erry elec know geology very well and could, themselves, make geological investigations. According to Brooks, it was very often possible during the war to observe French engineers using geological maps in the location of chelters.

Thus, although the French had organized no geological service, the good geological training of the officers permitted the army to exploit skillfully and opportunely the geological peculiarities of one area and another. In various cases, the French Army nade use of advisory civilian geologists.

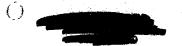
Erenz points out that in August 1917, from Fosse's position on the French front, German troops saveral times observed a civilian who went into shall believe and knocked on rocks with a herman. They called him the mountain spirit of Fossement. As was proven later by the interrogetion of prisoners and the testimony of spice, he was a military geologist in civilian clothes.

Throughout the whole course of the war, the French Army made wide use of existing and newly compiled maps, sections, and specialized, geological literature. All this material was supplied by civilian institutions. Tapocially noteworthy is the fact that the French were the first in the past var to pay great attention to the compilation of special maps which characterized the influence of soil conditions on terrain traversability. In the summer of 1916, in the Geographic Institute, where a number of outstanding geologists worked, the composition of "tank maps" was begun. With the old of geologists, the Institute undertook a description of the physicogeographical pseudicrities of the coulat theater and a resume of Germany's mineral resources and mining industries.

Information is very measur concerning the Bolgian Arms. From a private letter of the geologist, Ren'o [Fignend 2], to Brooks, it is known that the former chief of the military-engineering units of the Belgian Army, General Graindel, who was secretary of the Pelgian-Geological Society for a long time before the war, made full use of his good geological information on the combat theater.

The British Army was the first to feel the drawbacks of not having information on the geological conditions of an eros in which it had to wase war. In the very beginning of 1915, the commending staff ordered especial geology specialists from London, including Capteir King. The latter was attached as a geologict to the Chief of the Engineering Corps of the British Expeditionar, Army and was immediately assigned chief of the water-supply service. His basic duty was to clarify all questions connected with the evaluation of the water resources of the various areas. He was also charged with working out a system of preserving the surface waters in flat Flanders, an undertaking which had very great practical significance for the British Army both in offensive and defensive operations.

In a year's time the Eritish Amy initiated the use of geology in underground-mine werfere and organized an administration which was in control of work connected with the establishment of positions and the conduct of mine warfare. Colonel David, professor at Sydney University, was at first named as consultant geologist for these matters and was attached to the Engineering Corps, but afterwards he was named inspector of a tunnel company, attached to the General Staff, and chief of that specialized administration. From time to time other geologists and mining engineers from among the officers of the tunnel company, who knew the geology of the Western Front intimatoly, ware sesigned to this administration. They carried on military-geological investigations and compiled geological maps of theaters of impending combat. Moreover, from the very beginning of 1916, officers were assigned to each army for prospecting work, the results of which were systematically reported to



CHQ. In the British Army in Palestine there appearantly was an independent geological service, whose chief geologist was R. V. Brook (TR: Bibliography lists A. Brooks only).

The administration of the water-supply service, spart from its current field investigations and direct management of work on water-point installations, compiled water-supply maps, predominantly on the scale of 1:100,000. They contained a quantitative evaluation of the productivity of water points and of water resources (in L/sek) /liters per second 2/.

According to the testimony of many authoritative representatives of the British Army Command, the work of geologists secured the aucessa of very many engineering projects and military operations, particularly in the matter of organizing military water supply, the conduct of underground-mine warfers, and the search for mineral construction materials.

The American Expeditionary Forces had a special geological section attached to the chief angineer's staff. The chief geologist of this section headed the technical menagement of all army geological works, including hydrogeological investigation, which was carried out by a special water-supply section. In 1918, geologists were appointed on the besir of one for every corps. They were members of the chief engineer's staff and were in charge of all problems of geological prospecting, rendering practical aid to the water-supply service.

The American geologists emplied geology in diverse ways in verious types of fortification construction (terrain fortification, construction of shelters) and in the organization of water supply and the installation of water points.

In the solution of many practical tasks, wide use was made of geologists who had specially compiled maps and reports, and who had made personal observations. At the beginning of the war, the Americans very often used French or Belgian geological maps. Later, however, when more detailed geological investigations were carried out, they began to compile special engineering-geological maps. Maps of this type were compiled for all fronts on the scale of 1:50,000 and were constructed on the principle of demarcation of the strate of different lithological composition. Their importance in the construction of fortifications was pointed out in the description of the lithological diffe ency- I the strate in the legand.

In contrast to the maps of other armies, in American engineering maps, as a rule, important territory occupied by the enemy was clearly described. The American geologists compiled reports concerning the algoriticance of geology for fortification construction and underground mine laying, concerning conditions of river crossings, of the possible resources of surface waters, etc. The American geologists put an especially great amount of work into the compitation of accounts and specialized maps of water resources for areas occupied, by the enemy.

In the rear, American geologists were called upon to work on the search for strategic raw materials and the study of the enemy's mineral rescurces, both of which were important for military strategy.

The selection of important enemy industrial points for aerial and artillery bumberdient, and the furnishing of practical directions upon the most valuable and important objectives must be noted among the operational-tactical tasks which involved the participation of American geologists.

In the Maticaal Academy of Sciences in America, the Maticaal Research Council, composed of a whole series of sections and groups, was formed as an



aid to the military-goological section. Among the tuske of the geological and goographical continuous that of improving as old possibly from the of geologists and geographers' experience and information in working out all basic military problems. A great deal of attention was paid to the geological

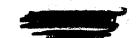
In the German Army in the beginning of World War I, the covered underestimated the role of geology, and military-goological cervices were laching.

preparation of officers.

Housver, the Gerran Army began to avail itself of the services of geology in various sectors, beginning in the wister of 1915-1915. It is known that in that worded willitury-applicated work commoted with water cupply, dvalaces, and the approximation geological conditions of fortification communication that cambee on the marthwest front in the eras of operations of the Fourth Acres and also in the Otraceburg Scrtifica ores. Geologists end hydrobsolmicions also conducted appeals detail work in the installation and toconditioning of wells. Lever, in the expension of the status of the grologisch session at tached to the Construction Administration, geologists undertook a systematic military-geological mapping of the Vector Bountains. Among their militarygeological works was the study of the subsoil and surface veters of the Bois de Pretro region in the Moscile River basin, carried out it the planter seed. opista Filipp and Roothst (Philipps and Horbst 1/. There inventigations rendered groups ald to the ermy of this meatur of the front. Anny becognization recognized and interference to exempted necessary, can be now the end of age the group of people the new expended to do men. The, performed the military-goological emiles of water supply end fraimage, reseaded for and ortracted close construction retorials, atualed the structural properties of the sample, and cormiled readily legible replay led maps. Almost at the vers time, in 1915, at the inevigation of geologists, the Special Geological Dureal was founded at the University of Lills and a library and laboratory for the saudy of the goology of Rolgium was established in Excepts (Goologist, A. Leplo). This sid which the verious Gazman armies saceived from goologist. at the beginning of the dar, largely on the princip initiative of the goolagiets, played its part, and the command began to recognize the nightineace and role of the asology of a terrain in its military undertakings. By the middle of 1915. We Comman Army Command indicated the appropriate of making grologiets available for estvicing and noos.

Military geology found efficiel recognition in the Gremen Almy only in 1917, when the Military-Geological Service was organized and attached to the Military-Topographical Section of the General Staft. Corresponding to the attracture of the military-topographical cirvice, military geologicals were formed into groups or sections which serviced the stay and operated with the various units on the tasks assagned by the section's commander. In all, there were 28 acctions. Apart from these organizations which carried out field work, there were also military-geological organizations in the reor and claging areas, the sections despited information sections. One of tiese was in Lille, enother in Bruccols and a third in Netz. These sections did not carry on field of trations and toro staffed by apologists to have geological literature and schiral material very well. The work of these sections was to occamble and systematize material, collate descriptions and maps necessary for the work of the field geologists, and to execute, in part, the laboratory proceeding of materials received from the front-line field sections.

Both field and reer geological sections or groups maintained close liaicon with the Central Military Geological Institute, founded in Berlin in 1916. The Institute bad at its disposal the archives, the library, and all the equipment of the Prussian Geological Institute. The receipt of materials was very difficult since the borders were closed. Therefore, the Institute bad about 100 of its workers in foreign countries, both belligerent and neutral. Throughout the war the Institute sent to the front up to 6,000 maps of



different types and much equipment of various rinds. All the work of the field and army /sic/ geologists was sent in to the Institute where it was introduction of the Institute was to draw conclusions intended for staffs and military units.

The Institute also compiled, and distributed to troop units, existing information and directive brochures, which were most often called "handbooks." Institute specialists also participated in preparing precepts and regulations. Naturally, a great part of those conclusions were not printed. Much of such material was lost without leaving a trace at the time of retreat. There are indications from the Czech geologist, Hlawks, to the effect that a great amount of such work was handed over to the French and the Dolgisms in time of pasce. There is no accurate information on the number of seclosists who torked in the German Army. It is only known that at the end of the war up to 260 non were working in the verious sections of military geology, the majority of whom were in military service.

In the Austro-Hungarian Army, the services of geologists were utilized occasionally but never systematically from 1915 on.

Military-geological groups, analogous to the German groups, formulated conclusions, which were here called reports, and drow up military-geological maps of various kinds (water supply, fortification construction, etc.). The geologiet, Elevks, briefly describes in his work, Geologie v rakensko-ukerske and de (Geology in the Austro-Hungarian Army), the specialized, geological maps of the Topographical Division in Trieste, with which he was acquainted.

Outstanding among the Czeche who worked in the field of military geology were the geologists, Panes, who did research on the Balkan caverns, Absolon, Gariner, and Jaxos.

Chrischeristically, the Austro-Eungarian Army, long before the organization of the military-geological service, who obliged to create a special unit for mountain work, detackments of so-called "Alpine Pevievers," composed of mountain telmbers who were charged with the study of mountain variate conditions. In the Balkens, the Austrians, making use of the Budapest and Hungarian Academies of Science, organized several expeditions, mainly for the purpose of making geological maps and doing research in the newly occupied territories. A geological map of the northern part of Albania was composed under the direction of the geologict, Kerner.

Geologists also worked in the Japanese, Italian, Turkish and Eulgerian Armies; however, the character and organization of their work is not known.

The Swies Army in 1914 had, in the hygienic section attached to its staff, engineer officers and military geologists, who worked on vater-supply problems.

Military Geology in World War II

Vith the termination of World War I, the direct use of geology for military needs was sharply cut down in most countries. However, the experience of World War I was not forgotten, and after the war the processing of accumulated material began in all countries, with the result that a vest literature on military geology was amassed.

In the USER a great deal of attention was devoted to the question of the use of geology in military science, as is testified by the bulk of material on military geology published in periodical literature. Shortly thereafter, the manuals of Andreyev and Benedictov on military geology appeared,



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the English geologist, King, in which the question of the use of geology in World War I is thoroughly elucidated. Although colleted works dealing with the work of Russian geologists at the fronts were never published, their basic findings were taken into consideration in planning the defensive measures of our country.

In other countries at that time, a great deal of material was published clarifying in its various phases the application of geology to military salmace. But the most extensive work, Material on the Geological Description of the Theaters of the 1914-1918 War (Material) po geologicheskormy opienniyu testrov voyay 1914-1918) (in 15 leaves) adited by Vil'zer (TM: transliteration of the Russian), treats in the main a range of purely geological questions without studying them from the military point of view.

Beginning in 1930, in all countries, but especially in German, military-geological literature took on an agitational character. Stress was laid on the question of the necessity in peacetime of proper training in military-geological servicing of armies for time of wer. A great deal of attention was paid to the military-geological training of officers. Large-scale ctudies of possible theaters of combat were intensively carried out. Various types of military-geological maps, sections, reference charts, sketches and descriptions were prepared in advance. Similarly, methods were perfected in compiling military-geological documentation in accordance with the changing character of warfers and the growing importance of such sine as eviation and tanks. Geologists were widely attracted to the various types of military engineering fortification, military-hydrotechnical work, etc., and to the study of the resources in strategic, mineral raw materials of one's own country and the cvaluation in this respect of the potentialities of other countries.

Geologists were frequently consulted during the entire preparatory fortification of state frontiers, both in France, where the Maginot Line was being erected, and in Germany with the setting up of the Siegfried Line, the Eastern Wall and other large-scale fortified regions.

In the Abyasinian campaign, the Italian Army made wide use of geological and hydrogeological data in the search for sources of water supply and for construction materials for laying out military roads.

During its occupation of the Westerr European countries, the German Fascist Army used specialized geological maps, which were in the possession of the unit and general staffs.

It is known that geological data was taken into account by the Japanese occupation forces in China.

Ho small part was played by Soviet military geologists in strengthening the defenses of the USSR. Even in time of peace, Soviet geologists carried out great preparatory works of all types of military-geological services for the ermy.

During the years of the Stalin Five-Year Plane, great investigating and prospecting expeditions were carried out in the study of the subsoil deplies and the geological features of our country. The materials gathered during these investigations are in a large measure studied for the general conclusions to be drawn from them, and they are used successfully for the various military needs both in the rear and at the front.

During the Finnish compaign, Soviet goologists randered great aid to the field forces of the Red Fray, fulfilling in very limited periods of time many complicated geological missions.





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Our forces made wide use of terrain-traversability maps and other specialized military maps compiled by geologists. The aid of geologists who know the natural conditions of the combat theeter facilitated the solution of many problems connected with the water supply of the troops, field-fortification construction, the construction and exploitation of air fields, etc.

From the very beginning of World War II, a great body of geology specialists was drawn to serve the immediate needs of the front. They very successfully aided the Red Army in the fight with the German invaders both in the organization of defence and in offensive operations.

The enormous extent of the zone of combat, which had extremely varied natural conditions, the mobile character of the war, the highly mechanized character of the army, the increased importance of tanks and motorized units and eviction, the complicated defensive works, all these together greatly emphasized the part played by military geology in World War II.

The swift tempo of the concentration and transfer of large numbers of troops and quantities of mechanized equipment alone demanded, first of all, the sid of geologists in the timely organization of the supply of good water for the twoops. The unselfish work of Soviet geologists and hydrogeologists, often directly on the foremost lines of the front, successfully secured water for the troops, thus cooperating in the execution of military operations.

Owing to the very active aid of Soviet geologists and hydrogeologists in a great number of large inhabited places, duplicate water-supply systems were successfully orested beforehend (artesian wells, shafts, etc.) and the undestrable consequences which occurred in other countries were avoided.

Soviet geologists also rendered very greet aid in fortification construction of all types in the field and in the tear (in technical organization of the ground, in the construction and improvement of roads, cirfields, etc.).

The services of the geologists who worked at the front in World War II were great, but no less great are the prospects of their participation, after the end of the war, in the tack of technically equipping the frontiers and the territory of the UESR.

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